WORKFLOW

Professional PCB production including galvanic PTH

- BASILNE
  - raw material cut to size (Ne-Cut)
  - CNC-drilling (BUNGARD CCD/2)
  - brush cleaning (RBM 300)
  - galvanic PTH (Compacta 30)
  - brush cleaning (RBM 300)
  - lamination of etch resist (RLM 419p)
  - vacuum exposure (Hellas)
  - spray developing (Splash / Jet 34D)
  - spray etching stripping of etch resist (Splash Center)
  - brush cleaning (RBM 300)
  - electroless tin (SUR-TIN)
  - lamination of solder mask (RLM 419p)
  - exposure of solder mask (Hellas)
  - spray developing (Splash / Jet 34D)
  - curing of solder mask (Hellas or hot air oven)
  - CNC-V-cut or CNC-routing (Bungard CCD/2)

- PROFILINE
  - raw material cut to size (Ne-Cut)
  - CNC-drilling (BUNGARD CCD)
  - brush cleaning (RBM 402 KF)
  - galvanic PTH (Compacta 40)
  - brush cleaning (RBM 402 KF)
  - lamination of etch resist (RLM 419p)
  - vacuum exposure (EXP 8000)
  - spray developing (DL 500)
  - spray etching stripping of etch resist (DL 500)
  - brush cleaning (RBM 402 KF)
  - electroless tin (SUR-TIN)
  - lamination of solder mask (RLM 419p)
  - exposure of solder mask (EXP 8000)
  - spray developing (DL 500)
  - curing of solder mask (EXP 8000)
  - CNC-V-cut or CNC-routing (Bungard CCD)

solder mask... Components printing... upgradeable to multilayer

- BASILNE
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  - brush cleaning (RBM 300)
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  - lamination of solder mask (RLM 419p)
  - exposure of solder mask (Hellas)
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- PROFILINE
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  - CNC-drilling (BUNGARD CCD)
  - brush cleaning (RBM 402 KF)
  - galvanic PTH (Compacta 40)
  - brush cleaning (RBM 402 KF)
  - lamination of etch resist (RLM 419p)
  - vacuum exposure (EXP 8000)
  - spray developing (DL 500)
  - spray etching stripping of etch resist (DL 500)
  - brush cleaning (RBM 402 KF)
  - electroless tin (SUR-TIN)
  - lamination of solder mask (RLM 419p)
  - exposure of solder mask (EXP 8000)
  - spray developing (DL 500)
  - curing of solder mask (EXP 8000)
  - CNC-V-cut or CNC-routing (Bungard CCD)

Sample Components printing

Sample outside multilayer

Sample inside multilayer

Film production with Bungard Filmstar
PRE-SENSITIZING SERVICE

We can coat boards that you supply with photoresist. The max. board size is 530 x 1160 mm, the min. board thickness is 0.5 mm. The board is cut to usable size by 20 mm on the short side (530 mm will go down to 510 mm). The rim is on request removed without charge.

PHOTORESIST

We coat the laminates with a special positive working liquid resist made according to our own recipe. The resist features highest exposure sensitivity, short processing times and large processing latitude. The equal and dust-free coating has a defined thickness of 5 µm. The maximum spectral response is in the range of 350 - 400 nm. The line resolution is limited only by the type of exposure unit. Typical exposure times are 90 seconds on a set with fluorescent neon tubes. The resist allows multiple exposure.

BUNGARD NEGATIVE PHOTO-COATED BASE MATERIAL

As an alternative to our Bungard Positive Liquid Resist, you can also have all raw plate formats coated with a negative-developing tenting resist. In contrast to the liquid, approximately 5 µm thick positive resist, the negative resist is 35 µm thick and is laminated as a film and packaged in a light protection paper.

In this resist, the exposed areas are hardened by the light and remain on developing. The film template must therefore be created as a negative. The exposure time on the Bungard Hellas is approx. 25 s and after the exposure a color change from light blue to dark purple can be seen directly. You need special negative developer. Negative laminate is advantageous in longer etching processes (e.g., with thicker SMD stencils) because the resist will withstand the spray beam longer by the larger resist thickness. Disadvantage is the sensitivity and short shelf life. Order only the currently required need and process the plates as soon as possible and only in the yellow room condition.

We also distribute laminators and photoresists on roll for self-laminating.

PHOTOSENSITIZED BOARD

The name ORIGINAL BUNGARD stands for highest quality and processing safety of pre-sensitized laminates. Like no other comparable product, this material allows a fast, flexible and faultless production of PCBs in small series and prototypes.

We use first-choice laminates approved and certified by UL, NEMA, DIN, IEC and others.

Several types of laminates, i.e. FR2, FR3, CEM1, and FR4 are available in thicknesses of 0.5, 0.8, 1.0, 1.6, 2.0 and 2.5 mm with either 18, 35 or 70 microns copper. The max. panel size is 510 x 1150 mm. Our cutting service provides sheets down to 50 x 50 mm min. size, with an accuracy of 0.1 mm.

Referring to our special developer, at 20 °C the developing time is less than 45 seconds. On the other hand, the resist is absolutely stable for more than 5 minutes in the developer. It is resistant to acid etching or galvanic chemicals and even permits alkaline etching at a pH-level less than 9.5.

The boards are protected against mechanical damage and unwanted exposure by a special, blue coloured adhesive foil. Due to this protective foil, no fl itters appear when cutting or milling the boards. Each board is subjected to chemical and physical controls and tests before and after coating.

A shelf life of more than 1 year under normal storage conditions is guaranteed. Even 10 year old boards still work.

STANDARD CUTTINGS FR4

<table>
<thead>
<tr>
<th>Format (mm)</th>
<th>1.5 mm</th>
<th>1.5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 µm Cu</td>
<td>70 µm Cu</td>
<td></td>
</tr>
<tr>
<td>210 x 300</td>
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<tr>
<td>200 x 250</td>
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<td>150 x 250</td>
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</tr>
<tr>
<td>160 x 233.4</td>
<td>160 x 233.4</td>
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<tr>
<td>150 x 200</td>
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<tr>
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<tr>
<td>75 x 100</td>
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</table>

PHOTOSENSITIZING SERVICE

We can coat boards that you supply with photoresist. The max. board size is 530 x 1160 mm, the min. board thickness is 0.5 mm. The board is cut to usable size by 20 mm on the short side (530 mm will go down to 510 mm). The rim is on request removed without charge.

PANELS FR4

<table>
<thead>
<tr>
<th>Format (mm)</th>
<th>0.5 - 1.5 mm</th>
<th>0.5 - 2.5 mm</th>
<th>0.5 - 2.5 mm</th>
<th>1.5 mm</th>
<th>1.5 mm</th>
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<tr>
<td>18 µm Cu</td>
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<td>105 µm Cu</td>
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<td>105 µm Cu</td>
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<tr>
<td>510 x 1150 x 0.5</td>
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<tr>
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<tr>
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<tr>
<td>510 x 570 x 0.8</td>
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<tr>
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<tr>
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<td></td>
</tr>
</tbody>
</table>

PANELS FR2

Format 480 x 1000 x 1.5 mm
35 µm Cu single or double sided

PANELS FR3

Format 510 x 1150 x 1.5 mm
35 µm Cu double sided

PANELS CEM1

Format 510 x 1150 x 1.5 mm
35 µm single sided

CUTTING SERVICE

We cut down all boards to non-standard sizes on request. The minimum board size is 510 x 1150 mm, the minimum size is 50 x 50 mm. Remains will be included. Boards >= 2 mm will be cut by saw. Saw cutting loss will be 3 mm per piece.
**SPECIAL PURPOSE LAMINATES**

Besides our ORIGINAL BUNGARD fotopositive coated base material we offer a wide range of laminates related to pcb manufacturing.

**Copper clad laminates**

FR4, CEM1, FR2, without photosensitive. Approvals and standards as for prepsensitized boards. The copper surface is not yet brushed.

- **FR4**, panel size 510 x 1150 mm,
  - Thickness 0.5 mm; Copper clad 18µm, 35µm and 70µm, single or double sided
  - Thickness 0.8 mm; Copper clad 18µm and 35µm, single or double sided
  - Thickness 1.5 mm; Copper clad 5µm, single sided; Copper clad 18µm, 35µm, 70 and 105µm, single or double sided
  - Thickness 2.0 mm; Copper clad 35µm and 70µm, single or double sided
  - Thickness 2.5 mm; Copper clad 35µm and 70µm, single or double sided

- **CEM1** panel size 510 x 1150 mm, Thickness 1.5 mm; Copper clad 35µm single sided

- **FR2** panel size 500 x 1000 mm, Thickness 1.5 mm; Copper clad 35µm single sided or double sided

- **FR2** is perfect for isolation milling, because routers and drills will last much longer.

**Drill backing boards**

Drill backing boards for drilling pcs e.g. with the BUNGARD CCD.

- **in stock:** 500 x 1000 x 2.5 mm
  - 500 x 1000 x 6 mm
  - 245 x 330 x 6 x mm

**Multilayer production**

- Prepregs (250 x 350 x 0.2 mm)
- outer layer (FR4 250 x 350 x 0.3 mm 18.00)
- inner layer (FR4 250 x 350 x 0.5 mm 18/18)
- separation foil (packing size for Prepregs and separation foil 50 pcs. each)

**Surface**

If you use ORIGINAL BUNGARD Photopositive Coated PCBs, there is a simple technical alternative to protect the surface of your PCB:

1. **Apply our immersion tin SUR-TIN just to the now open PADS.** The photoresist will stay on the tracks and protect them.
2. **Develop the photoresist after etching once again with a negative film (solder PADS open).**

**Image transfer** can be done either positive or negative. With a positive image you receive a blanc background and coloured writing or image. With a negative image you will receive a coloured background with blanc writing.

- The PCB panels can be mechanically processed. With careful handling they can be drilled and punched through the protection foil before exposure. The specially adapted developer is neutralized after the job and can be disposed into the drain. No hazardous waste is created.

**BUNGARD COTHERM**

For many applications customers demand a better thermal dissipation. One possible solution for heat problems are so called metal core boards, which consists of a 35 µm copper layer, a 100 µm isolation layer (FR4) and a 1000-2000 µm Aluminium layer. Bungard offers this PCB type with brand name Cotherm. Cotherm is available with or without photosensitive resist and in these formats.

**Metal core board:**

- **Cotherm 1000**: 100/35 µm; Format 530 x 1150 mm, (1.0 mm, 1 x 35 CU)
- **Cotherm 1500**: 100/35 µm; Format 530 x 1150 mm, (1.5 mm, 1 x 35 CU)
- **Cotherm 2000**: 100/35 µm; Format 530 x 1150 mm, (2.0 mm 1 x 35 CU)

**Cotherm** can be processed like normal base material. Please note, that the isolation layer is very thin.

**ALUCOREX PRESENSITIZED ALUMINIUM**

This product is perfectly suitable to manufacture front panels, machine or information plates as well as tampon printing clichés. ALUCOREX consists of an aluminium alloy which is anodized in a unique treatment sequence. After anodizing we coat the boards with a specially adjusted, high-resolution and resistant positive photo-coat. To protect the coat from mechanical damage or unintentional exposure we provide the boards with a light protection foil.

- **Making a front panel from ALUCOREX** is simple and safe. The procedure takes only minutes and you need no equipment besides an exposure unit and a developing tray.
  - **Exposure and developing**
    - **exposure and developing** take together only 5 minutes.
    - The colour of the ALUCOREX-boards is already established in the scratch, light and chemical proof anodized layer. The exposed parts of this layer are removed during the developing process.

**FR4 THIN LAMINATE**

*in 0.125 mm and 0.2 mm thickness*

For semiflex application and multilayer!

The Bungard semiflex base material combines the advantages of the simple processing of the Bungard standard base material with flexibility for special applications.

**Board formats:**

- 100 x 160 mm 35 µm Cu
- 210 x 300 mm 35 µm Cu
- 510 x 1150 mm 35 µm Cu

Please note that we sell boards of 100x160 only in units of 35 and 210x300 only in units of 8 boards.
SMD STENCILS
FOR SOLDER PASTE APPLICATION
From now on, there is a quick, cheap and easy way to make your metal template on your own. With already existing machines and without interference of existing processes. To do so we offer both positive or negative pre-sensitized metal templates in many dimensions, in different thicknesses and hardnesses.

Being coated with a chemically resistant photoresist of high line resolution and steepness, these templates offer you all the advantages already known from the presensitized laminates for PCBs.

Brass boards are available in 500 x 1000mm. Thicknesses: 0.2, 0.3, 0.4, 0.5, 0.8 and 1.0 mm. Other thicknesses on request possible.

German Silver (CuNiZn) board size 280 x 1000. Thicknesses: 0.1, 0.15, 0.2, 0.3, 0.4 and 0.5. Other thicknesses on request possible.

NE-CUT
BOARD CUTTER
The Board Cutter Ne-Cut was specially developed to cut PCBs up to 3.0 mm of thickness or aluminium up to 1.5 mm. If desired cutting of steel sheets up to 1mm or plastic up to 5 mm is possible as well as cutting of film sheet material or paper. With the transparent hood and the removable downholder you can cut pieces „on sight“.

Features
- Cutting width max. 530 mm
- Two blades made of hardened and ground steel
- Spring loaded built-in clamping unit in the front (removable)
- Bedstop with metric scale in the right front
- Fully adjustable back stop with metric scale for batch work (0...300 mm)
- Angle and scale tolerance 0.1 mm
- Durable full steel construction
- All important parts angular adjustable
- Simple exchange of blades
- Adjustable cutting angle
- Adjustable clearance

STENPRINT 3000
STENCIL PRINTER
The StenPrint3000 is a manual printing system with a stable base for a high print quality. The solid construction provides clean and reproducible pressure with simple handling, even with small components and fine structures down to 0.5 mm.

It is ideally suited for the production of prototypes and small series. In the basic model, one-sided and double-sided printed circuit boards can be printed with the help of the magnetic circuit board holders.

For this purpose, the circuit boards are fixed on the base plate and supported by the magnetic circuit board holders. By means of rotatory knobs, the print alignment can be performed quickly and easily in X-Y and Theta axis.

A parallel lift ensures a clean separation of the printed circuit board and stencil and guarantees a perfect print image.

For double-sided printing you can fix the pcb with the magnetic pcb-holders (this is mandatory when using the universal stencil clamping frame).

VARIATIONS
Three types of stencil supports are available.
Stencil holder / frame
For the simplest of tasks, there is the universal stencil holder frame in which the stencil can be easily clamped without tension.

Stencil clamping frame
Optimal is the use of the universal stencil clamping frame. Various stencil sizes can be used here. The tensioning is carried out from two sides. No perforation of the stencil is required.

Mounting rail
The third option is a mounting rail for the use of fixed aluminum frames or common quick-release systems.
**FILMSTAR-PLUS PHOTO Plotter**

Filmstar-Plus is the name of the next generation of our bitmap photoplotter series. Optimized for inhouse production of high end film layouts at reasonable price level the system can directly proceed (extended) Gerber files (RS 274X or RS 274C) or bit/ bitmap (.bmp) files.

**Features:**
- Film is fixed on a rotating drum. A highly focused red light laser diode is moving stepwise alongside that drum, driven by a precise stepper motor with worm and gear drive. Of course, all settings are software adjustable, calibrated and controlled.
- Full software package belongs to extend of delivery. It offers all required functionality like film arrangement, reverse and mirror image selection, preview, print preview, printing of apertures (e.g. for soldermask films oversizing) and lots more

**Features:**
- Precise edge definition in photo quality
- Perfect blackness results in perfect opacity
- Extended software package included in delivery

**Improvements compared to Filmstar FP 8000:**
- Higher resolution, up to 16 256 x 25 400 dpi
- Stand alone unit - no separate PC necessary.

**Bungard Laser Direct Imaging (LDI)**

Bungard LDI, UV laser direct imaging system for all common types of photoresists.

**Target Customers are electronic developers with frequent layout changes, who want to process their PCB prototypes (e.g. antenna structures), in wet processing technology according to industrial standards. Most samples shown here were typically made in about 3 minutes.**

The laser head has a resolution better than 50 microns and will be available either as an add on item for existing CCD machines as well as a complete CNC system that can not only expose but also drill and route.

The Bungard Laser Direct will be able to expose a Eurocard pcb in about 15 minutes, depending on the packing density and aspect ratio. To control the laser unit the software LaserPro is required. In LaserPro travel speed, travel height, light energy and start delay (Prelight) can be set for currently 1 - 15 tools.

LaserPro processes HPGL data (HPGL 7475A) in the same manner as the other operating software for the Bungard CCD RoutePro and DispPro. If necessary, the CAD-CAM software IsocamPro is required to convert Gerber Data into HPGL travel paths.

After exposure, the boards can be developed and etched like our normal presensitized base material. The Bungard LDI does not remove copper from the substrate. When lasering copper dangerous gases are produced, that need special collecting neutralizing and disposal measures. In our opinion, etching is the far more user friendly option.

With the Bungard Laser Direct Imaging prototypes can be realized more quickly and accurately than with previous technology. For small series production, we still recommend to make a layout film with the Bungard Filmstar and expose with the Hellas or - for finer resolution - with the EXP 8000.

The Bungard Laser head and the software LaserPro are offered at an unbeatable price. They can be retrofitted to all Bungard CCD machines younger than in 2006. Ask us for a quote!
HELLAS
VACUUM EXPOSURE UNIT
High precision vacuum exposure unit especially designed for double sided contact exposure of presensitized base materials such as tampon printing clichés, PCBs, front-panels, daylight films and other UV sensitive coatings.

Features
- 2 x 6 superactinic UV-tubes, each 20 W
- Special reflectors for minimum undercut
- Analogue light emission display
- Lower exposure surface from 8 mm special glass
- Upper exposure area from structured mylar foil in a sturdy frame
- Working area 570 x 300 mm
- Suitable for fine-line PCBs
- Maintenance free vacuum (80%) with gauge display, 1380 l/hour continuous rating
- Digital timer 1 second - 9 min 59 sec. with count-down, auto-reset and beeper
- Built-in cooling fan allows long time exposure or baking processes
- Separate choice of upper/lower exposure possible
- Sturdy steel housing

EXP 8000
PARALLEL BEAM EXPOSURE UNIT
The EXP 8000 is a high speed double sided exposure machine mainly designed for industrial production and equipped with two 4000 W mercury halide lamps. These lamps in about 900 mm distance from the PCB ensure almost parallel light.

Construction
Sturdy, welded tube frame with coated sheetplates. The chassis consists of a sliding drawer system and a yellow light table in the machine’s front.

Operation
EXP 8000 guarantees a perfect exposure within a minimum of time and energy consumption. A touch display allows easy preset and read out of all settings. UV-light emission controllers are not necessary with LED technology because the bulbs have a lifetime of plus 10.000 hours with very constant light emission.

A vacuum pump provides a close and uniform contact between artwork and board. The machines have powerful cooling fans for the LEDs.

Features EXP 8000:
- Max. Working area 600 mm x 600 mm (recommended: 400 mm x 500 mm)
- Vacuum assisted drawer
- Suitable for fine line PCBs
- Suitable for exposure and curing of solder mask.
- Built-in yellow light table
**JET 34D**

**SPRAY ETCHING MACHINE**

Powerful spray-etching or spray-developing machine mainly designed for use in PCB labs. Capacity up to 3m²/h possible (single-sided, positive material).

**Features**
- Maintenance free system with self-cleaning nozzles
- Etching speed of 35µm Cu within 90 seconds (warm Fe-III-Cl)
- Line resolution better than 0.1 mm
- Big lid for easy loading, with built-in security switch
- Recommended board size: 300 x 400 mm
  (Maximum 350 x 450 mm)
- Small PCBs can be fixed on carrier with adjustable holder
- Easy and clean handling by hinge free lid and handle outside of machine
- If you turn the carrier you can etch double sided
- Overflow wash tank in the front for rinsing etched boards
- Digital timer with countdown, auto-reset and beeper
- Sturdy construction fully made of PVC and titanium

**SPLASH**

**SPRAY ETCHING MACHINE**

Spray etching machine for laboratory use with integrated static rinse. Machine is suitable for double sided material. Special emphasis was put on ergonomic and clean etching and rinsing as well as low chemical drag out.

**Features**
- Maintenance free system with self-cleaning nozzles and magnetic pump
- Etching speed of 35 µm Cu within 90 seconds (warm Fe-III-Cl)
- Big window to the etching chamber made from transparent PVC.
- Maximum board size: 210 x 300 mm
  (Splash XL: 300 x 400 mm)
- Line resolution better than 0.1 mm (100 µm)
- Suitable for all common etchants
- Lid to the etching chamber with safety switch
- Removable board holder made from Titanium and PVC. Can be locked in drip-off position
- Easy access to the etching chamber.
- Strong 1000 W Quartz heater, controlled by thermostat
- Overheat fuse
- Digital timer with countdown, auto reset and beeper.
- Integrated rinsing zone with drip off holder
- 3 cog valves for all tanks
- Suitable for spray developing

**Specifications**

**JET 34D**

- **Dimensions (LxWxH):** approx. 600 x 700 x 1100 mm
- **Power supply:** 220 V~., 1.5 kW
- **Tank capacity:** 16 l
- **Weight:** 35 kg

**SPLASH**

- **Dimensions (LxWxH):** 600 x 660 x 1200 mm
- **Power supply:** 230 V~, 50 Hz, approx. 1.5 kW
- **Tank capacity:** approx. 25 l

**SPLASH XL**

- **Dimensions (LxWxH):** 800 x 650 x 1200 mm
- **Power supply:** 230 V~, 50 Hz, approx. 1.5 kW
- **Tank capacity:** approx. 40 l
SPASH CENTER

SPRAY ETCHING MACHINE

Laboratory etching machine with static and spray rinse, integrated developer tank, a reserve tank for e.g. chemical tinning and a squeeze dryer. The Splash-Center is suitable for double-sided PCBs. Special emphasis was put on ergonomic and clean etching and rinsing as well as on low chemical drag out.

Etching compartment:
- Maintenance free etching system with solid stream nozzles
- Etching speed of 35 µm Cu within 90 seconds (warm Fe-III-Cl)
- Big window to the etching chamber made from transparent PVC.
- Maximum board size: 210 x 300 mm /Splash-Center XL: 300 x 400
- Line resolution better than 0.1 mm (100 µm)
- Suitable for all common etchants. Fe-III-Cl recommended
- Lid to the etching chamber with safety switch
- Removable board holder made from Titanium and PVC. Can be locked in drip-off position
- Easy access to the etching chamber.
- Strong 1000 W Quartz heater, etching temperature controlled by thermostat
- Overheat fuse
- Digital timer with count down, auto reset and beeper.
- Integrated rinsing zone with drip off holder
- 3 cog valves for all tanks
- Suitable for spray developing

Developer and rinse compartment:
- Magnetic centrifugal pump to revolve developer
- two integrated static rinses, one can be used for neutralization purposes
- Fresh water spray zone activated by foot switch, including splash protection
- A reserve tank, e.g. for immersion tin
- 5 ball valves to drain all tanks, cover protected from the front side.
- All tanks with lids
- Integrated drip tray for all tanks, sure-footed about 120 mm above the ground
- Integrated mechanical squeeze dryer

Power supply: 230 V~, 50 Hz, 1.5 kW
Dimensions (LxWxH): 1000 x 670 x 1200 mm
Working Level: 900 mm
Etchingformat: 210 x 300 mm
Tank capacity: 1 x 25 l + 1 x 9 l + 3 x 7 l
Weight: 46 kg

SPASH CENTER XL

Power supply: 230 V~, 50 Hz, 1.5 kW
Dimensions (LxWxH): 1160 x 770 x 1200 mm
Working Level: 900 mm
Etchingformat: 300 x 400 mm
Tank capacity: 1 x 40 l + 1 x 24 l + 3 x 15 l
Weight: 56 kg

Features:
- Working width 510 mm
- Adjustable conveyor speed 0 - 1.5 m/min.
- Joint free belt drive
- PCB is firmly secured by upper and lower transport rollers
- Powerful etchant pump (200 l/min)
- Double sided etching with 4 x 14 flat jet nozzles. Due to special nozzle pattern, there are 6 rows of nozzles for each side!
- Adjustable spray pressure. Upper and lower spray pressure can be regulated separately
- Thermostat with digital read out and self-safe overheat cut-off
- Integrated rinse zone. Optional fresh water rinse with solenoid valve or recyclewatertank
- Drying by squeezing rollers with tissue

Power supply: 230 V or 400 V, 50 Hz, 1.5 kW
Dimensions (LxWxH): 1200 x 670 x 1290 mm
Etchingformat: 300 x 400 mm
Tank capacity: 55 l
Weight: 100 kg

DL 500

CONVEYORISED SPRAY ETCHING MACHINE

The DL 500 is a double sided conveyorised spray etching machine with integrated rinsing zone. This machine is easy to maintain and fits perfectly to a modern PCB laboratory. The maximum capacity within one hour is 10 m². Designed for being used for laboratory purposes, there are lots of different applications (e.g. spray developing of tenting or solder mask) and options available. Of course the machine can be modified according to your needs.

Power supply: 230 V or 400 V, 50 Hz, 1.5 kW
Dimensions (LxWxH): 1200 x 670 x 1290 mm
Etchingformat: 300 x 400 mm
Tank capacity: 55 l
Weight: 100 kg

Features:
- Working width 510 mm
- Adjustable conveyor speed 0 - 1.5 m/min.
- Joint free belt drive
- PCB is firmly secured by upper and lower transport rollers
- Powerful etchant pump (200 l/min)
- Double sided etching with 4 x 14 flat jet nozzles. Due to special nozzle pattern, there are 6 rows of nozzles for each side!
- Adjustable spray pressure. Upper and lower spray pressure can be regulated separately
- Thermostat with digital read out and self-safe overheat cut-off
- Integrated rinse zone. Optional fresh water rinse with solenoid valve or recyclewatertank
- Drying by squeezing rollers with tissue
- Sturdy stand alone construction from PVC and Titanium
- Transparent top with security switch
- Line definition down to 35 µm lines and spaces on 18 µm copper
- 1000W quartz heater
- Maintenance free design, just normal cleaning/refilling
- Easy disassembly and full access to all inner parts without special tools
- Suitable for all regular etching agents. We recommend to use ferric-chloride. Please pay attention to the special features of each etchant (crystallization of persulfates and ammonium, exothermic reactions while etching). For alkaline etching, machine must be modified.

Page 18
Variants of the DL 500

Variant 1: Spray Developing Machine
The DL 500 can be used as a spray developing machine for negative and positive etch resist or solder mask without modifications. Simply change the media!

Variant 2: Spray Etching Machine
Standard variant

Variant 3: Spray Stripping Machine
This machine is equipped with an additional filter basket at the front side of the machine to remove residues of tenting or solder mask from the stripping liquid (see picture on the left).

Options for the DL 500

Option 1: Recycling Rinsing Tank
Recycling rinsing tank with magnetic centrifugal pump instead of fresh water. Saves water costs. With a cock drain valve the used rinsing water can be used to compensate evaporation losses or to make up new etching liquid. Waste water free rinsing technique. The magnetic valve from the standard version is here obsolete. The tank fits underneath the machine body of DL 500.

Dimensions (LxWxH): 200 x 700 x 600 mm

Option 2: Conveyorised Rinsing Unit
a.) Conveyorised rinsing unit, stand alone version with adjustable conveyor speed, integrated magnetic valve for fresh water inlet (controlled by DL 500), squeeze drying roller. Transport width and height same as DL 500.

Dimensions (LxWxH): 450 x 620 x 940 mm

b.) As above but second stage cascade rinse (in combination with recycling rinsing tank and magnetic centrifugal pump), 3 way cock valve to bypass rinsing water e.g. to water treatment unit IONEX.

Dimensions (LxWxH): 450 x 620 x 940 mm

Option 3: Inspection Table
Control zone in form of a roller table (not conveyorised). This roller table can be mounted between two DL 500 (e.g. Developer and Etcher), between DL 500 and rinsing unit or as a single exit table.

Dimensions (LxWxH): approx. 620 x 50 x 530 mm

Option 4: Production Line
3 DL 500 and the rinsing unit can be connected to a small production line (Developing – Etching – Stripping – Cleaning) coupled together with inspection tables. Of course other variants are possible as well.

Option 5: DL 500 S
This machine is equipped with an additional filter basket at the front side of the machine to remove residues of tenting or solder mask from the stripping liquid.

Option 6: DL 500 Vario
DL 500 Vario with separate adjustable spray pressure for the upper and lower side. For physical reasons the etching result from the upper side is different from the lower side. Adjusting the spray pressure for one side may compromise this phenomena. In contrast to etching machines from competitors the PCB in the DL 500 is firmly fixed throughout the whole process by upper and lower transport rollers. This makes it possible to switch off completely the upper nozzles without lifting the PCB by the spray pressure of the lower nozzles.

Option 7: Cooler
Some etching agents as well as other chemicals tend to exothermic reactions and need to be cooled during the treatment process. For this purpose we offer a special cooler for the DL 500. The Cooler consists of a recycling rinsing tank with cooling coils for the etching liquid. With a cock valve the etching agent is adjustable bypassed through the cooler.

Option 8: DL 500 triple phases power supply
You can order the DL 500 either with a single phases or triple phases power supply. Triple phase power supply is recommended for permanent use.

Option 9: Filter unit
On request you can equip your DL 500 with one or two 10” filter units to remove residues from the etching process. You can easily adjust the filter throughput via cock valve. On the picture you can see a filter unit together with an exit table.

Option 10: Exit table

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TITAN 3500

ROTATION WHEEL ETCHER FOR DOUBLE SIDED SHEETS

The Titan 3500 is a double-sided spray etcher for high precision applications.

In addition to the patented nozzle system, which ensures uniform wetting of the substrate, the substrate is rotated during the etching process to reliably prevent the formation of an etch shadow and uneven etching by e.g. the trace geometry. This enables structure resolutions down to 40μm with a copper thickness of 35μm.

As material PVC and PP are used, all metal parts that come into contact with the etching medium are made of titanium, e.g. the titanium heating. The side walls and tank bottom are made of 8 mm thick PVC.

This results in an extremely robust compact construction. The high-precision etching result is achieved by the uniform volume flow of the nozzle spray bar in conjunction with the rotating clamping wheel and the uniform liquid flow of the etching medium.

The special nozzles are internally designed in such a way that the full spray cone strikes the rotating etch material with a twist.

During the etching process, the clamping wheel is constantly rotated via a geared motor and transport rollers.

The titanium heating is controlled by a digital thermostat. The etchant pump is controlled by a digital timer with automatic reset and final acoustic signal. Setting range 0-599 seconds.

**Specifications**

- **Power supply:** 230 V~, 50 Hz, ca. 2.2 kW
- **Dimension (LxDxH):** 950 x 750 x 1100 mm
- **Working height:** 1150 mm
- **Usable format:** max. 350 x 350 mm
- **Tank volume:** 28 l
- **Etching pump:** Magnetic centrifugal pump with approx. 80l/min throughput (gross)
- **Weight:** 90 kg
- **Digital-timer for time range:** 0-599 sec.
- **Temperature range:** 0 – 55 °C
- **Height cog valve (emptying):** ca. 300 mm
SPRINT 3000
CUSTOMIZED ETCHING SYSTEM FOR YOUR PCB LABORATORY.

The Sprint (3000/4500/6000) series is made for double sided PCBs with line resolution down to better than 0,1 mm. Machine is available as table top or floor standing version. With this range of products, complete production lines are possible covering developing, etching and rinsing including waste water treatment.

Outstanding feature is the transport unit, which is fully removable for cleaning purposes and may be extended or shortened almost arbitrarily, and thus allows custom changes or machine designs. Standard machine has a width of 300 mm (SPRINT 3000) but wider machines are available (450 mm = Sprint 4500 / 600 mm = Sprint 6000).

AQUAPUR 1000
WASTE WATER TREATMENT SYSTEM

AquaPur (1000 / 3000 / 5000) cleans rinsing water from solids and heavy metals such as copper or iron of small to medium series of PCB production.

The ion exchangers of this system are suitable for alkaline and acidic rinse water from the etching process. The use of a special mixed bed resin for anions and cations, which can be regenerated, avoids the use of other chemicals e.g. for pH adjustment and ensures easy operation.

The system operates in closed loop circulation and is directly connected to the respective rinsing zones of the etching machine. The spray pressure and the flow rate can be read and adjusted at the diaphragm valve and the Flow meters.

The contaminated rinse water of the machine flows into a storage tank integrated into the AquaPur.

Possible options:
- Working width: 450 mm / 600 mm for Sprint 4500/6000
- Sensor control for fresh water rinse (motion control)
- Additional suction hood, swiveling
- UPPER / LOWER pressure adjustable via cog valve
- Additional rinsing sections possible
- Etching zone can be enlarged to 2x / 3x / 4x length
- High pressure pump for rinsing
- Titanium cooling coil, electrically controlled to reduce bath temperature in case of danger of exothermic reaction
- Run dry protection (double security for heater elements)
- Underframe with or without security tray
- Transmitting height up to 10mm (e.g. for pad printing cliches)
- Can be supplied with waste water treatment unit
- Oscillation module possible

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IONEX A, B, KA, KB

WASTE WATER TREATMENT SYSTEM

The name IONEX stands for ION-EXchanger, which is the very heart of this modern waste water treatment system. The Ionex is a modern and compact plant to treat rinsing water of a PCB laboratory. We offer 4 basic variants, which differ in rinsing water throughput and ion capacity. Type A and B are equipped with a cotton pre-filter, two cation columns and a pH neutralization column. Type KA and KB have three ion exchange columns.

The cation columns color red, when loaded with ferric ions and blue/green, when loaded with copper ions. Loading of anion column can be tested by measuring the conductance of the cleaned water. Loaded columns can be sent to Bungard for regeneration or we support you to do the regeneration yourself.

The drain water quality from this system is in accordance to German directives, which are of the highest standards world wide!

Features:
- For post-treatment of etching and galvanic rinsing water
- Removal of solids and all heavy metals
- Closed water cycle possible (K-versions)
- Decrease of chemical oxygen demand
- Integrated storage sump with capacity of 110 l (A/KA) or 220 l (B/KB) for collecting rinsing water
- Strong built-in hose pump
- Integrated cotton filter candle 10 µm (active carbon filter with K-versions)
- Significant change of color when loaded with metals
- Lower and upper sump level control switch
- Easy handling and operation
- Regeneration of ion exchange resins by supplier or by user at little cost
- IONEX A and B perform additionally pH neutralization and discharge to the drain

IONEX A / KA

| Power supply: | 230 V, 50 Hz, 50 W |
| Weight: | 30 kg |
| Cleaning capacity: | 10 l/h |
| Dimensions (LxWxH): | 700 x 430 x 1300 mm |

IONEX B / KB

| Power supply: | 230 V, 50 Hz, 100 W |
| Weight: | 60 kg |
| Cleaning capacity: | 20 l/h |
| Dimensions (LxWxH): | 900 x 600 x 1500 mm |

Closed loop rinsing water:
IONEX KA and KB filter next to the metallic cations also the anionic halogens from the rinsing water, so you receive demineralized water. The demineralized water is collected and pumped back to the etching or through-hole-plating machine.

As an option the IONEX can be equipped with a conductivity meter (IONEX KA/KB) or a ph-meter (IONEX A/B). This way you have the quality of the treated rinse water always under control.

Closed loop rinsing water:
IONEX KA and KB filter next to the metallic cations also the anionic halogens from the rinsing water, so you receive demineralized water. The demineralized water is collected and pumped back to the etching or through-hole-plating machine.

Of course the machines of the IONEX family can be adapted according to your needs. The IONEX XXL e.g. cleans 1500 l of rinsing water. The IONEX AU filters gold ions out of rinsing water from a nickel-gold-processing machine. These gold ions can be regenerated and returned to the gold bath.

IONEX scheme A-B

IONEX scheme KA-KB

As an option the IONEX can be equipped with a conductivity meter (IONEX KA/KB) or a ph-meter (IONEX A/B). This way you have the quality of the treated rinse water always under control.

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ACCESSORIES FOR YOUR PCB - LAB

Processing Dishes for PCB lab.
Rigid trays suitable for developing, etching, stripping, immersion tinning.
The trays, which have a spout to facilitate emptying, are available in three sizes.
Insize:
350 x 450 x 75 mm
250 x 320 x 60 mm
210 x 260 x 50 mm

Stripper for positive and negative photoresists
Green Coat solder paint
Developer for positive presensitized boards
Chemicals for galvanic through hole plating
Developer for negative presensitized boards
Sodium peroxide
Immersion tin SUR-TIN
Stain remover RX 3

FAVORIT

THROUGH-HOLE-PLATING
Hand-operated machine, especially for mechanical through-hole-plating purposes. Professional through-hole-platings by individual tools for each rivet diameter. Optimal contacts, even without soldering. Favorit offers high quality results at a low cost level.

Special features:
- Adjustable depth limiter
- Maximum board size: 400 mm

Extend of delivery:
- The offered system includes complete press + tools
- Inclusive 1 x 1000 rivets
- Inclusive 1 set of tools
- Various tools and rivets are available
- Please specify the inner diameter you require
- Different tools have to be used for different diameters

FAVORIT

Rivet with inner diameter/mm: 0.4 0.6 0.8 1.0 1.2 1.5
Required drill diameter/mm: 0.6 0.8 1.0 1.5 1.7 2.0
Dimensions (LxWxH): approx. 95 x 300 x 210 mm
Working depth: 200 mm
Weight: approx. 4 kg

Design and equipment compliant with the requirements of:
- EU directive 95/16/EC
VARIODRILL
PCB DRILLING SYSTEM

VARIODRILL is a PCB drilling machine for prototypes and small batch production.

The demand for operating comfort and high quality has led to an untraditional design which meets the necessary requirements for an ergonomic correct working position.

Features:
- Comfortable working position, drill table can be tilted up to 30°
- Magnifier optics directly over the drill hole (parallaxes free)
- Illuminated work area
- Motor controlled, adjustable stroke speed, spindle underneath the table
- Infinitely adjustable 10,000 ... 30,000 RPM
- AC Motor, 100 Watts / 230 Volt
- Including foot switch for easy operating
- Booth hands are free for positioning the PCB
- Complete system with integral dust extraction
- Throat depth: 115 mm, max. board size 230 mm x endless
- Chuck: 1/8" (3.2 mm)
- Drill size 0.6 to 3.2 mm
- Chuck: 3.175 mm
- Dimensions (LxWxH): 340 x 240 x 175 mm
- Weight: approx. 7 kg
- Power supply: 220 V~, 50Hz, approx. 0.6 kW
- Including external vacuum cleaner

DRILLS AND ROUTERS
SOLID CARBIDE

High quality, precision ground solid carbide drill and routing bits with 3.175 mm (1/8") shaft.

All tools have 7.5 mm wide collets with a distance of 21 mm from the tip to the upper side of the collet.

The tool rings show the diameter or are colour coded. Tools come in re-usable plastic boxes.

Within one class of price, tools with different diameters can be mixed to give one unit of 10 pc.

**Special tools for isolation milling < 0.6 mm**

SC/FT Router cylindrical:
- 0.3, 0.4 and 0.5 mm
- Bungard Special isolation milling routers
- 0.1 and 0.2 mm

These routers are cylindrical only in the last millimetre. This way there is a low risk of breaking the router.

**Contour Routers - RPU Type**
For Aluminium routing/milling. Two flutes, upward swarf ejection, fish tail tipped. On-stock diameters: 0.6, 0.8, 1.0, 1.2, 1.5, 2.0, 2.5, 3.0 mm

**Contour Routers - SC/FT Type**
For PCB routing, diamond shaped teeth, upward swarf ejection, fish tail tipped. On-stock diameters: 0.6, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0 mm

**Contour Routers - G60°N Type**
For isolation routing with or for engraving, two flutes, 60° tip angle. For Channels of 0.2 – 0.5 mm width (depending on cutting depth).

**V-Cut Routers G30°N Type**
For isolation routing and fine engraving, two flutes, 30° tip angle. For Channels of 0.1 – 0.3 mm width (depending on cutting depth).

**Tungsten Carbide Drills for drilling PCBs**
Two flutes, righthand turn. Diameter: 0.3 ... 3.0 mm in 0.1 mm increments

**Contour Routers - SC/FT Type**
For Aluminium routing/milling. Two flutes, upward swarf ejection, fish tail tipped. On-stock diameters: 0.6, 0.8, 1.0, 1.2, 1.5, 2.0, 2.5, 3.0 mm
CHEMICAL ETCHING OR ISOLATION MILLING

In general, chemical etching needs a film artwork or a laser direct imaging, but, the etching itself is extremely cheap and thus standard in worldwide printed circuit board production. Isolation milling does not need film artwork, but, generates high tooling costs and some application problems. That is why isolation milling is more for first and single prototypes.

Problem with isolation milling is, that worldwide - prepregs are made for etching application and in order to fill gaps of 35µm. Since isolation milling channels are deeper, there is a high risk in production. Air inclusions not filled by resin of the prepreg may end up in short cuts (if touched by a plating through hole) or lead to delamination during e.g. reflow soldering process, due to the expansion of the air bubble.

Copper coated aluminium PCBs as normally used in LED applications (Cotherm)

Construction: 0.035 mm copper plus 0.1 mm separation prepreg plus 1.5mm aluminium carrier.

No problem in etching technology. Just need to cover back side and edges of the board to avoid etching of the carrier.

Problem: milling technology may destroy isolation layer and burrs may lead to short cuts.

Thin FR4 boards

Construction: 0.035 mm copper, double side, plus 0.1 mm or 0.2 mm FR4 Layer

No problem in etching application because FR4 carrier is not effected by etchant.

Multilayer boards with standard prepregs for etching

Construction: 0.035 mm copper 0.2 mm inner layers plus 0.1 mm separation prepreg

No problem in etching application because FR4 carrier is not effected by etchant.

State of art for multilayers should be the etching technology. To avoid layout film production, etching can be combined with Laser Direct Imaging (LDI), to compare advantages of both technologies!

Problem with isolation milling is, that worldwide - prepregs are made for etching application and in order to fill the gap of normal copper thickness of 35µm. Since isolation milling channels are deeper, there is a high risk in production. Air inclusions not filled by resin of the prepreg may end up in short cuts (if touched by a plating through hole) or lead to delamination during e.g. reflow soldering process, due to the expansion of the air bubble.
## Bungard CCD Series CNC Machines

<table>
<thead>
<tr>
<th>Model</th>
<th>Weight kg</th>
<th>Dimensions mm</th>
<th>Work area mm</th>
<th>Tool change</th>
<th>Milling and drilling</th>
<th>Milling/drilling RF &amp; microwave substrates</th>
<th>Milling/drilling multilayers with up to 16 layers</th>
<th>Contour routing of PCBs</th>
<th>Milling flexible, rigid-flex PCBs</th>
<th>Engraving front panels/labels</th>
<th>Wave solder pallets and Housing production</th>
<th>Milling SMT soldering paste stencils and solder frames</th>
<th>UV-laser-exposure</th>
<th>Panel cutting, Reworking PCBs</th>
<th>Test adapter drilling</th>
<th>Cooling</th>
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</thead>
<tbody>
<tr>
<td>CCD/2-ECO</td>
<td>30 kg</td>
<td>700x550x300</td>
<td>270x325x38</td>
<td>yes</td>
<td>★★★★</td>
<td>★★★★</td>
<td>★★★★</td>
<td>★★★★</td>
<td>★★★★</td>
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<td>★★★★</td>
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<tr>
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<td>700x550x300</td>
<td>270x325x38</td>
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<td>700x800x300</td>
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<td>700x800x300</td>
<td>325x495x38</td>
<td>yes, 16 tools</td>
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<td>★★★★</td>
</tr>
</tbody>
</table>

*for flexible materials, vacuum fixation is a nice option

*) we generally recommend to etch at least the inner layers of a multilayer PCB

**) for flexible materials, vacuum fixation is a nice option

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BUNGARD CCD/2-ECO

CNC MACHINE

The Bungard CCD/2-Eco completes the Bungard CNC segment for the low price level. This machine is especially interesting for beginners with a low budget, because it has on the one hand an unbeatable price, but on the other hand offers the same mechanic quality and precision of all other Bungard CNC machines.

In opposite to all other CCDs, this machine is equipped with a low-cost eco-spindle which allows speeds from 5000 up to 35000 U / min. For normal everyday work such as isolation milling and contour milling of printed circuit boards, this spindle is highly sufficient. For aluminum and non-ferrous metals however not. Of course the machine can be retrofitted at any time thereafter with a high-speed spindle.

The CCD/2-Eco is a high quality Computer Controlled Drilling machine with semi-automatic tool change. It allows direct processing of Excellon / Sieb & Meyer drill data or HP/ GL data for the production of printed circuit boards (drilling, milling, isolation routing) and milling/engraving of plastics.

In addition to the spindle the Bungard CCD/2-Eco can be upgraded with a dispensing device for solder paste or glue, a laser exposure head for exposing photoresists and aluminium work table, routers engine adapter for plastic milling and many more.

SCOPE OF DELIVERY:

• Mechanic unit + control unit + complete cabling
• Superb and sturdy high frequency spindle with eddy current brake and load control
• Integrated mechanical milling depth limiter and pressure foot
• Driver software RoutePro3000 (Windows 7™, Windows 10™ - 64bit) for drilling and milling
• Powerful, adjustable (500-2000 W) + start adapter for vacuum cleaner (vacuum cleaner not included in delivery)
• Manual, USB/serial adapter, Set of Allen Keys

OPTIONS:

• Vacuum table, protection hood or protection rack, converter software Isocam, fiducial recognition and calibration with camera, laser exposure of photo resists, aluminium work table, routers engine adapter for plastic milling and many more.

OPTIIONS:

• Upgrade to Kavo high-frequency spindle (this requires: Spindle holder 33mm, spindle 4010, inverter in Al-housing for mounting on the Y-carriage, 8-wire Chainflex control wire).

BUNGARD CCD/2-ECO

Weight: 30 kg
Dimensions (LxWxH): 700 x 550 x 300 mm
Work area: 270 x 325 x 38 mm
Tool change: semiautomatic 99 tools
Power supply: 110-240 V, 50-60 Hz + vacuum cleaner (1500W) (not included in delivery)
Range of RPM: 5000 – 35000
Traveling speed: 1 – 9000 mm/min
Software resolution: 0,0000 mm (0,1 µm)
Mechanical resolution: step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (~ 6.35 µm)
Tool diameter: 0.1mm – 3,175 mm (recommended, bigger tool diameter possible)
Position accuracy: 20 ppm (0.002%) over the entire work space
Maximum position speed per axis: 9000 mm/min (~150 mm/s)
Maximum working speed per axis: 9000 mm/min (~150 mm/s), individual setting on a per-tool basis, independent from position speed
Drill speed: 5/s (= 9.000 holes/h= 150 holes/min)
Required accessories: Computer
Board fixation: span fixing, clamp fixing, reference pin system, stack processing possible
Option: vacuum fixation

BUNGARD CCD/2-ECOMTC

Weight: 30 kg
Dimensions (LxWxH): 700 x 550 x 300 mm
Work area: 270 x 325 x 38 mm
Tool change: semiautomatic 99 tools
Power supply: 110-240 V, 50-60 Hz + vacuum cleaner (1500W) (not included in delivery)
Range of RPM: 5000 – 35000
Traveling speed: 1 – 9000 mm/min
Software resolution: 0,0000 mm (0,1 µm)
Mechanical resolution: step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (~ 6.35 µm)
Tool diameter: 0.1mm – 3,175 mm (recommended, bigger tool diameter possible)
Position accuracy: 20 ppm (0.002%) over the entire work space
Maximum position speed per axis: 9000 mm/min (~150 mm/s)
Maximum working speed per axis: 9000 mm/min (~150 mm/s), individual setting on a per-tool basis, independent from position speed
Drill speed: 5/s (= 9.000 holes/h= 150 holes/min)
Required accessories: Computer
Board fixation: span fixing, clamp fixing, reference pin system, stack processing possible
Option: vacuum fixation
**BUNGARD CCD/2**

**CNC MACHINE**

The Bungard CCD/2 is a high quality Computer Controlled Drilling machine with semi-automatic tool change. In contrast to the CCD/MTC the CCD/2 has a half sized work area (325 x 270 compared to 325 x 495mm) and an integrated control unit underneath the table.

Compared to the ATC models, the software interrupts the operation during the tool change and the new tool is changed manually (turning the knobs changes by a quarter turn, motors remain empowered and hold the position).

The CCD/2 has the same robustness and precision as all the other CCD models. It is ideal as an entry-level model for isolation milling. If you want to operate the CCD/2 with cooling, you need to protect the control unit from the cooling. Please contact us beforehand.

In contrast to all other CCD models, the machine zero point is at the front left. The X-axis is the traverse over the table, whereas the Y-axis is located on table level. The CCD/2 cannot be converted to automatic tool change. If you possibly want to upgrade at a later time, please contact us before purchase. If necessary we can create a special version for you.

**SCOPe OF DELIVERY:**

- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful, adjustable (500-2000 W) vacuum cleaner + Start adapter for vacuum cleaner
- Manual, USB/serial adapter, Set of Allen Keys

**Available options:**

- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressors, etc.

**Explains:**

MTC = Manual Tool Change

ATC = Automatic Tool Change

**BUNGARD CCD/2**

<table>
<thead>
<tr>
<th>Weight:</th>
<th>30 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (LxWxH):</td>
<td>700 x 550 x 300 mm</td>
</tr>
<tr>
<td>Work area:</td>
<td>270 x 325 x 38 mm</td>
</tr>
<tr>
<td>Tool change:</td>
<td>semiautomatic 99 tools</td>
</tr>
<tr>
<td>Power supply:</td>
<td>110-240 V, 50-60 Hz + vacuum cleaner (1500W)</td>
</tr>
<tr>
<td>Range of RPM:</td>
<td>30 000 - 63 000</td>
</tr>
<tr>
<td>Traveling speed:</td>
<td>1 – 9000 mm/min</td>
</tr>
<tr>
<td>Software resolution:</td>
<td>0,0001mm (0,1 µm)</td>
</tr>
<tr>
<td>Mechanical resolution:</td>
<td>step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 4.35 µm)</td>
</tr>
<tr>
<td>Tool diameter:</td>
<td>0.1mm – 3.175 mm (recommended, bigger tool diameter possible)</td>
</tr>
<tr>
<td>Position accuracy:</td>
<td>20 ppm (0.002%) over the entire work space</td>
</tr>
<tr>
<td>Maximum position speed per axis:</td>
<td>9000 mm/min (= 150 mm/s)</td>
</tr>
<tr>
<td>Maximum working speed per axis:</td>
<td>9000 mm/min (= 150 mm/s), individual setting on a per-tool basis, independent from position speed</td>
</tr>
<tr>
<td>Drill speed:</td>
<td>5/s (= 18 000 holes/h= 300 holes/min)</td>
</tr>
<tr>
<td>Required accessories:</td>
<td>Computer</td>
</tr>
<tr>
<td>Board fixation:</td>
<td>span fixing, clamp fixing, reference pin system, stock processing possible</td>
</tr>
<tr>
<td>Option:</td>
<td>vacuum fixation</td>
</tr>
</tbody>
</table>
BUNGARD CCD/2 ATC

CNC MACHINE

The Bungard CCD/2/ATC is a high-quality Computer Controlled Drilling machine with automatic tool change. The CCD/2/ATC differs from the CCD/ATC by a half sized working area (325 x 270mm). The CCD/2/ATC is ideal for users, who do not have enough space to run an ATC machine.

SCOPE OF DELIVERY:
- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro 3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful adjustable (500-2000 W) vacuum cleaner + start adapter for vacuum cleaner
- Manual, USB/serial adapter, Set of Allen Keys
- ATC: Air hose

Available options:
- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

Explains:
- MTC = Manual Tool Change
- ATC = Automatic Tool Change

Weight: 30 kg
Dimensions (LxWxH): 700 x 550 x 300 mm
Work area: 270 x 325 x 38 mm
Tool change: 16 automatic / semiautomatic 99 tools
Power supply: 110-240 V, 50-60 Hz + vacuum cleaner (1500W)
Range of RPM: 3,000 – 63,000
Traveling speed: 1 – 9000 mm/min
Software resolution: 0,00001 mm (0,01 µm)
Mechanical resolution: step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 3,175 µm)
Tool diameter: 0.1mm – 3,175 mm (recommended, bigger tool diameter possible)
Position accuracy: 20 ppm (0.002%) over the entire work space
Maximum position speed per axis: 9000 mm/min (=150 mm/s)
Maximum working speed per axis: 9000 mm/min (=150 mm/s), individual setting on a per-tool basis, independent from position speed
Drill speed: 5/s (= 18,000 holes/h= 300 holes/min)
Required accessories: Computer
Board fixation: span fixing, clamp fixing, reference pin system, stack processing possible
Option: vacuum fixation

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**BUNGARD CCD MTC**

**CNC MACHINE**

The Bungard CCD/MTC is a high quality Computer Controlled Drilling and milling machine with semi-automatic tool change (MTC = manual tool change).

The CCD/MTC differs from the CCD/2 by a larger working area (325x495mm in contrast to 270x325mm) and by a separate controller.

Compared to the ATC models, the software interrupts the operation during the tool change and the new tool is changed manually (turning the knob changes by a quarter turn; motors remain empowered and hold the position).

With the sturdy spindle and the good fixation of the tool in the chuck the Bungard CCD / MTC is perfectly fitted for routing or engraving plastics, aluminium and other metals. 19 inch rack boards can also be processed.

**SCOPE OF DELIVERY:**
- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro 3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful adjustable (500-2000 W) vacuum cleaner + start adapter for vacuum cleaner
- manual, USB/serial adapter, Set of Allen Keys

**Available options:**
- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

**Explains:**
- MTC = Manual Tool Change
- ATC = Automatic Tool Change

**Weight:** 35 kg

**Dimensions (LxWxH):** 700 x 800 x 300 mm

**Work area:** 325 x 495 x 38 mm

**Tool change:** semi-automatic 99 tools

**Power supply:** 110-240 V, 50-60 Hz + vacuum cleaner (1500W)

**Range of RPM:** 3.000 – 63.000

**Traveling speed:** 1 – 9000 mm/min

**Software resolution:** 0.00001mm (0.01µm)

**Mechanical resolution:**
- stepresolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 3.175 µm)

**Tool diameter:** 0.1 mm – 3.175 mm (recommended, bigger tool diameter possible)

**Position accuracy:**
- 20 ppm (0.0002%) over the entire work space

**Maximum position speed per axis:**
- 9000 mm/min (= 150 mm/s)

**Maximum working speed per axis:**
- 9000 mm/min (= 150 mm/s), individual setting on a per-tool basis, independent from position speed

**Drill speed:** 5/s (= 18.000 holes/h= 300 holes/min)

**Required accessories:** Computer

**Board fixation:** span fixing, clamp fixing, reference pin system, stack processing possible

**Option:** vacuum fixation

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BUNGARD CCD ATC

CNC MACHINE

The Bungard CCD/ATC is a high quality Computer Controlled Drilling machine with Automatic Tool Change (ATC). The ATC as well as all other CCDs allows directly processing of Excellon / Sieb&Meyer drill data or HP/GL route data for producing pcb's (drilling, cut-out-routing, isolation milling) or routing/engraving plastics, aluminium and other metals. The CCD/ATC differs from the CCD/MTC by the automatic 16-slot tool changer. The work space is the same. Compared with the CCD/2 the ATC has a larger work space (325x495mm in contrast to 270x325mm with the CCD/2) and a separate control unit.

The ATC is ideal for big and more complex PCBs with many different drill sizes. 19 inch rack boards can also be processed.

SCOPE OF DELIVERY:

- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro 3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful, adjustable (500-2000 W) vacuum cleaner + start adapter for vacuum cleaner
- Manual, USB/serial adapter, Set of Allen Keys
- ATC: Air hose

Available options:

- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

Explains:

- MTC = Manual Tool Change
- ATC = Automatic Tool Change

Weight: 35 kg
Dimensions (LxWxH): 700 x 800 x 300 mm
Work area: 325 x 495 x 38 mm
Tool change: 16 automatic / semiautomatic 99 tools
Power supply: 110-240 V, 50-60 Hz + vacuum cleaner (1500W)
Range of RPM: 110.240 V, 50-60 Hz
Traveling speed: 1 – 9000 mm/min
Software resolution: 0,00001 mm (0,01µm)
Mechanical resolution: step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 3,175 µm)
Tool diameter: 0.1 mm – 3,175 mm (recommended, bigger tool diameter possible)
Position accuracy: 20 ppm (0.002%) over the entire work space
Maximum position speed per axis: 9000 mm/min (~150 mm/s)
Maximum working speed per axis: 9000 mm/min (~150 mm/s), individual setting on a per-tool basis, independent from position speed
Drill speed: 5/s (~ 18.000 holes/h= 300 holes/min)
Required accessories:
- Computer
- Board fixation:
  - span fixation, clamp fixing, reference pin system, stack processing possible
  - Option: vacuum fixation
The Bungard CCD/MTC is a high quality Computer Controlled Drilling and milling machine with semi-automatic tool change (MTC = manual tool change).

The CCD/MTC XL differs from the CCD/MTC by a larger working area (500x600 mm in contrast to 325x495 mm).

Compared to the ATC models, the software interrupts the operation during the tool change and the new tool is changed manually (turning the knob changes by a quarter turn, motors remain empowered and hold the position).

With the sturdy spindle and the good fixation of the tool in the chuck, the Bungard CCD/MTC XL is perfectly fitted for routing or engraving plastics, aluminum and other metals. 19 inch rack boards can also be processed.

SCOPE OF DELIVERY:
- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro 3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful, adjustable (500-2000 W) vacuum cleaner + start adapter for vacuum cleaner
- Manual, USB/serial adapter, Set of Allen Keys

Available options:
- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

Explains:
- MTC = Manual Tool Change
- ATC = Automatic Tool Change

Weight:
49 kg

Dimensions (LxWxH):
950 x 950 x 300 mm

Work area:
500 x 600 x 38 mm

Tool change:
semiautomatic 99 tools

Power supply:
110-240 V, 50-60 Hz + vacuum cleaner (1500W)

Range of RPM:
3.000 – 63.000

Traveling speed:
1 – 9000 mm/min

Software resolution:
0.00001 mm (0.01 µm)

Mechanical resolution:
step resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 3.175 µm)

Tool diameter:
0.1 mm – 3.175 mm (recommended, bigger tool diameter possible)

Position accuracy:
20 ppm (0.002%) over the entire work space

Maximum position speed per axis:
9000 mm/min (=150 mm/s)

Maximum working speed per axis:
9000 mm/min (=150 mm/s), individual setting on a per-tool basis, independent from position speed

Drill speed:
5x (= 18.000 holes/h or 300 holes/min)

Required accessories:
Computer

Board fixation:
span fixing, clamp fixing, reference pin system, stack processing possible

Option: vacuum fixation
BUNGARD CCD XL ATC

CNC MACHINE

The Bungard CCD/ATC/XL is a high quality Computer Controlled Drilling machine with Automatic Tool Change (ATC).

The ATC/XL as well as all other CCDs allows directly processing of Excellon / Sieb&Meyer drill data or HP/GL route data for producing PCBs (drilling, cut-out-routing, isolation milling) or routing/engraving plastics, aluminium and other metals.

The CCD/ATC/XL differs from the CCD/MTC/XL by the automatic 25-slot tool changer. The work space is the same.

Compared with the CCD/ATC the XL has a larger work space (500x600mm in contrast to 495x325mm with the CCD/ATC) and the number of tool slots (25 instead of 16).

The ATC is ideal for very big and complex PCBs with many different drill sizes and for special applications.

SCOPE OF DELIVERY:

- Mechanic unit + control unit + complete cabling
- Superb and sturdy high frequency spindle with eddy current brake and load control
- Integrated mechanical milling depth limiter and pressure foot
- Driver software RoutePro 3000 (Windows 7™, Windows 10™-64bit) for drilling and milling
- Powerful, adjustable (500 - 2000 W) vacuum cleaner + start adapter for vacuum cleaner
- Manual, USB/serial adapter, Set of Allen Keys
- ATC: Air hose

Available options:

- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

Explanations:

MTC = Manual Tool Change
ATC = Automatic Tool Change

Best choice for PCB production in large quantities

BUNGARD CCD XL ATC

- Weight: 49 kg
- Dimensions (LxWxH): 950 x 950 x 300 mm
- Work area: 500 x 600 x 38 mm
- Tool change: 25 automatic / semiautomatic 99 tools
- Power supply: 110-240 V, 50-60 Hz + vacuum cleaner (1500W)
- Range of RPM: 3.000 – 63.000
- Traveling speed: 1 – 9000 mm/min
- Software resolution: 0.0001 mm (0.01 µm)
- Mechanical resolution: Software selectable: 1 mil, ½ mil, ¼ mil (= 3.175 µm)
- Tool diameter: 0.1 mm – 3.175 mm (recommended, bigger tool diameter possible)
- Position accuracy: 
  - Maximum position speed per axis: 20 ppm (0.002%) over the entire work space:
  - Maximum working speed per axis: 9000 mm/min (= 150 mm/s), individual setting on a per-tool basis, independent from position speed
- Drill speed: 5/s (= 18.000 holes/h= 300 holes/min)
- Required accessories: Computer
- Board fixation: span fixing, clamp fixing, reference pin system, stack processing possible

Option: vacuum fixation
BUNGARD CCD PREMIUM

CNC PREMIUM MACHINE

An international trendsetter on the world market for printed circuit board production is the Bungard CCD PREMIUM. It combines all available highlights, required in a modern PCB lab, to a fully equipped CNC center.

Details:

- Highest possible speed of 22m/minute
- Extremely high step resolution of 1 µm
- 32 Bit chip technology for extremely quick communication under Windows 8™ (or higher)
- Direct USB Port for easy installation
- High precision aluminium table, double sided overmilled, for about zero height tolerance
- Low maintenance costs due to linear belt drive in x- and y-direction

Standard features:

- Two synchron, in parallel working stepper motors for X-axis for max possible stiffness
- 100.000 1/min spindle for smallest tool diameters
- 300 W spindle
- Stepper motor torque adjustable via software
- 30 tool boxes for automatic tool change
- Tool length measurement and calibration incl. tool break control
- Integral pressure foot and depth limiter system
- Dust extraction with autostart function via software
- Rollrack with transparent doors with security switches

Standard software supplied with the system:

- Software resolution 0.1µm
- LOG files for perfect and automated online support.
- ROUTEPRO 3000 inclusive all modules:
  - Plus 3000
  - LaserPro 3000
  - DispPro 3000
  - Document 3000
  - Calibrate 3000
  - Inspect 3000

Technical details/requirements:

- Power supply: 90-250 V AC / 47-63 Hz or 124-370V DC (without options and dust extraction)
- Compressed air: 6 bar, +/- 40 liter/minute
- Dimensionen machine: +/- 800 x 950 x 600 mm
- Weight machine: +/- 80 kg
- Dimensionen rack: +/- 900 x 1100 x 1600 mm
- Weight rack: +/- 100 kg

Available options:

- Laser head for LDI
- Dispenser
- Super silent compressor
- Chiller for spindle in heavy use

Coming soon:

- Version with 60.000 1/min spindle
- Remote control of system via smart phones
- Vacuum table

Note: Computer does not belong to scope of delivery.

For latest details scan QR-Code or look at BUNGARD website:

www.bungard.de
Bungard CCD Premium

best choice for PCB production in large scale and with very fine tools or Laser Direct Imaging in high resolution e.g. in HF application
CCD ACCESSORIES

HARDWARE
The CCD is extensible through a variety of options, such as:
- Protective hood, CAM / Isolation software, monitor + camera, cooling device, compressor, etc.

SOFTWARE
Bungard standard software RoutePro3000 can be expanded with additional software modules, such as:
- LaserPro 3000, DisPro 3000, Calibrate 3000, Inspect 3000, Document 3000 or Plus 3000

Starter Kit for Bungard CCD
To work directly with your Bungard CCD, some accessories are required. For our new customers we arranged a starter kit according to our experience.

Optional enhanced dust extraction system (instead of standard nozzle) offers:
- higher efficiency
- lower noise
- more effective travel height

One integral part of the CCD is to keep it multifunctional.
Exchanging the high frequency spindle with a pen plot adapter changes the CCD into an A3 Pen plotter.

Pressure foot for drilling and routing.

On request the CCD is delivered with a vacuum table.

For dust and noise protection we offer sound-proofing hoods and racks.

The USB camera will allow optical inspection of your board.

Depth limiter.

With few steps you can equip the CCD with a coolant supply.
Spindle speed setting by software from 30000-63000 1/min (5.000 - 100.000 1/min for CCD Premium)

Inclusive spindle quick stop

TOP EQUIPMENT:
- Support of manual tool change (MTC) or automatic tool change (ATC)
- Driver software for Excellon, Sieb & Meyer or HP / GL data on Windows XP ...
- Windows 8 (32- or 64-bit) with convenient user interface
- Improved tool-statistics with parameters for up to 99 tools
- Screen presentation of milling vectors and drill holes
- Selection of vectors to be processed + drill holes using the mouse on the screen
- Working progress indicator on the screen
- Real-time capability with handshake on work progress for controlled operation and stops
- In combination with optional USB CAMERA, picture is displayed on the computer screen with a crosshairs target.
- For upgrade of machines elder than 2006, we can convert the controller of the CCD.

For detailed description see following pages.

The design concept of Routepro 3000 computer-aided manufacturing (CAM) tool is to operate the BUNGARD CNC hardware. This will enable you to run the software on your CAD computer in your R&D department or on any other separate computer in a production plant. As you like.

That meets the requirements of the modern workplace. The designer can finish the prototype straight away himself or start the next CAD job, e.g. with ISOCAM 5.0 and pass the PCB production to a machine operator. That way your Bungard CCD in combination with Routepro 3000 is used for large scale production of printed circuit boards. You will be supported by a wizard that leads through the project end of course by an online help function.

FEATURES:
- Modern optics with Windows 7 ribbon bar, floating or docking windows
- Machine and tool parameters are stored job related
- A wizard ensures that all tools are properly provided with parameters
- Tool parameters can be stored according to material and router or drill type
- Language module for easy translation
- Machine configuration graphically interactive
- All parameters (speeds, scaling, offset, etc.) configurable.
- You may position the machine by moving the cursor and clicking with the mouse in the camera screen. It will also try to center the drill hole. This can be useful if you want to capture the holes from an existing PCB.
- Under the Views tab you now have the following extra’s:
  - Under the Help tab you’ll find two buttons to open the location of the current project and the documentation.

CCD OPTIONS

PLUS 3000
Bungard extra modul

With this module activated you will get the following extra features:

- Under the Views tab you now have the following extra’s:
  - Show material
  - Set the intensity of the line grid
  - Set the intensity of the dot grid
  - Show the mounting holes
  - Show the ATC tool-slots and depth sensor
  - Under the Help tab you’ll find two buttons to open the location of the current project and the documentation.

Designed as software package for all BUNGARD CCD CNC systems (later than 2006), RoutePro 3000 integrates all standard functionality of previous Bungard software platforms such as:
- Drilling and routing of circuit boards
- Isolation milling and engraving
- Routing and engraving of front panels and housings
- Production of SMD templates

...
You have a dispense unit installed and want to calibrate the PCB, so the dots will be placed correctly.

Calibrate 3000
Bungard Calibration Module
With the calibration module, you can visually calibrate the position of your board. The software moves and rotates the board according to the actual position of the calibration marks or registration holes.

For this purpose, the machine automatically drives to certain fiducial registration points on the layout and the user centers the cross mark of the camera over the mark and acknowledges the position. Registration holes can be easily inserted e.g. with IsoCam. Height calibration is also possible with the help of standardized templates.

The calibration function is useful if you e.g. do not want to work with reference pins for double-sided boards, or the board has been changed by other process steps (pressing multilayer, galvanic through hole plating), so the reference pins may lead to inaccuracies.

Another typical application is the rework, e.g. if other components assemble the circuit board can no longer be fixed with reference pins to the base.

Rework could also be:
- You received a board from a customer and the adjustment holes of the board are too small and you need to drill them with a bigger tool.
- You have a dispense unit installed and want to calibrate the PCB, so the dots will be placed correctly.
- You want to cut a hole in a PCB that was already finished.
- You want e.g. calibrate a possible offset between drilling-milling spindle to a dosing needle or the laser exposure head.

LaserPro 3000
Bungard Laser Module
The Bungard laser unit is an add-on item for the Bungard CCD to expose photoresists, solder masks and Alucorex. The laser is mounted into the spindle holder instead of the high frequency spindle and is controlled by the RoutePro 3000 software.

The Bungard laser exposure unit is an answer to the demand of many operators for higher precision, faster processing speeds and reduced tool costs compared to other technologies as for example isolation milling.

The LaserPro 3000 is a brilliant videos in vivid colours. HD video recording at 720p, records up to 30 pictures per second in real HD quality. Clear Frame Technology:
- Laser class: class 3B
- Power: 120mW
- HD-Video with 720p, Autofocus, high precision lens with glass elements delivers sharp image quality. TrueColor Technology, automatic exposure for brilliant videos in vivid colours, HD video recording at 720p, records up to 30 pictures per second in real HD quality. Clear frame technology: exceptional even in low light conditions for smooth, detailed videos
- Optimized for Windows 8. Quick set-up, no driver installation required.
- Dimensions (LXBXH): 47 x 47 x 110 mm
- Windows 8, Windows 7, Windows Vista, Windows XP (SP2) or higher
- Power connection: Magnetic safety switch, laser turns on only when laser is mounted facing down into the CCD holder PVC housing
- USB 2.0, Hard disc: 1,5 GB of free storage
- Power connection: Input Voltage: 100 – 240 VAC
- Internal Voltage: 5-7 bar
- Air outlet: 0,1-7 bar
- Hold back vacuum: Non-Drop System
- Control: Via Bungard CCD/Routepro3000
- Dispensing license DispPro3000
- Via Bungard CCD
- Dispensing license DispPro3000
- Disppro 3000
Bungard Dispensing Module
The dispensing module DispPro 3000 is an extension of the CCD for dispensing solder paste or glue.

Instead of being controlled by a foot switch, a pneumatic manual dispensing unit is controlled over the software module Disppro 3000. A dosing cartridge of the dispenser is mounted into the holder of the high-frequency spindle.

The module is not a fully automatic dispensing unit, but a dosing aid for a manual dispenser.

The machine drives precisely to each dosing point and dosing time dosing height are precisely controlled.

Further settings like viscosity control and control of the dosing volume are not supported. The control of these parameters is subject to the user.

Document 3000
Bungard Documentation Module
This documentation module will provide outstanding documentation which you can use for future reference. You may also handout the project documentation to your customer along with the finished boards.

When the documentation module is activated you’ll find a new button under options: PDF. Pressing this button will generate a complete PDF document, containing all the machine settings. This includes activated licenses, correction factors, serial numbers, tool defaults for routers, drills, laser and dispense tools and many more.

DispPro 3000
Bungard Dispensing Module
The dispensing module DispPro 3000 is an extension of the CCD for dispensing solder paste or glue.

Instead of being controlled by a foot switch, a pneumatic manual dispensing unit is controlled over the software module DispPro 3000. A dosing cartridge of the dispenser is mounted into the holder of the high-frequency spindle.

The module is not a fully automatic dispensing unit, but a dosing aid for a manual dispenser.

The machine drives precisely to each dosing point and dosing time dosing height are precisely controlled.

Further settings like viscosity control and control of the dosing volume are not supported. The control of these parameters is subject to the user.

Inspect 3000
Bungard Inspection Module
With this module you can use a Bungard CCD for AOI-drives (Automatic Optical Inspection).

If you have started Inspect3000, the machine will travel to the first drill position and waits there, so you have time to look at this position closely. If you press start, the next position will be shown.

Note: This function will only work on drill layers.

Externall: This function will only work on drill layers.

DISPPRO 3000

Dimensions: 220 x 210 x 67 mm
Weight: 1 kg
Input Voltage: 110 – 240 VAC
Internal Voltage: 24 VDC
Air inlet: 5.7 bar
Air outlet: 0.1-7 bar
Hold back vacuum: Non-Drop System
Control: Via Bungard CCD/Routepro3000
Requirements: Bungard CCD
Dispensing license DispPro3000
For Routepro3000 connection to compressed air
Application: Dosing of solder paste and glue

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QUALITYSCAN 3000

What is QualityScan 3000?
QualityScan 3000 is a fully integrated, stand-alone process control, measurement and inspection workstation for use in many applications in multiple industries.

QualityScan 3000 uses a PC Windows based software package integrated with a high-resolution, calibrated, A3 size flatbed scanner. This combination allows for inspection of parts at virtually any stage of production. Parts can be inspected versus Gerber data, CAD data or Golden parts.

Benefits:
- Catch problems BEFORE production floor – “Virtual problem”
- Catch problems DURING production – “Sampling for SPC”
- Eliminate REWORK
- Environmentally friendly
- Maximize existing capital investment
- Reduce operator, engineer & management stress

Why QualityScan 3000?
- QualityScan 3000 systems are the standard in the industry for PCB, stencil, emulsion screen/film inspection – it’s the leading system in the world!
- Inspection is needed - It is not acceptable to ship or use defective parts!
- QualityScan 3000 is the lowest cost complete inspection system in the industry
- 100% inspection of parts using CAD data or a Golden Part
- Inspect a wide variety of features on a single system – multi purpose
- Inspection of parts in any material including FR4, Polyamide, Rodgers, Thermount.
- Or plastic, paper, diazo, glass, chrome, electroform, stainless, silicon, etc
- Systems are very easy to use and based on a standard PC platform
- Optionally, create or modify CAD data to match existing parts when data is lost

Power consumption:
45 W
2.8 W (Low mode)
0.5 W (Standby)

Dimensions (LxWxH): 656 x 458 x 158 mm

Scan resolution:
2400 dpi x 4800 dpi

Absorbance:
3.8 Dmax

Weight:
approx. 14.5 kg
IsoCAM 5.0 for Win XP ...Win7 64 bit offers updated hardware drivers with improved dongle management. We recommend all existing IsoCAM users (that have a dongle = user identification already) to upgrade their system to this standard.

Find download full version and demo version (for new users) on our website.

The answers:

- IsoCAM reads your Gerber, HPGL and drill files. It offers you editing facilities like shift, mirror, copy, paste, delete and more on single vectors, groups of elements or entire layers.
- IsoCAM can convert data into all of the above mentioned formats. Windows Postscript output allows making film artworks.
- IsoCAM comes with a worthy isolation milling converter with the feature of using two different tools in once and with the possibility of creating copper rubout areas.
- The aperture table and the tool rack can be edited, saved and printed. A converter automatically reads the aperture information from most CAD packages.
- Optional up-grade to ISOCAM PRO enables to load .bmp and .dxf files.

The situation:
You designed a PCB with your CAD package and now want to make a prototype or a small series by etching or by isolation milling.

IsoCAM 5.0 for Win XP ...Win7 64 bit offers updated hardware drivers with improved dongle management. We recommend all existing IsoCAM users (that have a dongle = user identification already) to upgrade their system to this standard.

The questions:

- How do you check and correct the drill-, route- and plot-data, their dimension and layer registration?
- Do you want to make your prototype by isolation milling?

The answers:

- IsoCAM reads your Gerber, HPGL and drill files. It offers you editing facilities like shift, mirror, copy, paste, delete and more on single vectors, groups of elements or entire layers.
- IsoCAM can convert data into all of the above mentioned formats. Windows Postscript output allows making film artworks.
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- Optional up-grade to ISOCAM PRO enables to load .bmp and .dxf files.
COMPACTA 30

THROUGH-HOLE-PLATING LINE

This machine from the COMPACTA-series was consequently designed to meet the demands of professional direct metallization.

It can take boards up to 210 x 300 mm² and has 5 treatment tanks (cleaning - pre-dip - catalyst - intensifier - reserve tank) and one galvanic plating tank.

Two treatment tanks are thermostatically controlled and equipped with a teflon heater.

Bath movement on all tanks is performed with DC-gear motor. The stroke speed is stepless variable.

The galvanic plating tank comes with an integrated air injection and a stepless regulated rectifier.

A Volt- and an Amperemeter show the current electric values.

<table>
<thead>
<tr>
<th>COMPACTA 30</th>
<th>Tank treatment</th>
<th>dimensions tanks</th>
<th>galvanic copper tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length: 400 mm</td>
<td>400 mm</td>
<td>Width: 100 mm</td>
<td>275 mm</td>
</tr>
<tr>
<td>Depth: 300 mm</td>
<td>300 mm</td>
<td>Capacity: 10 l</td>
<td>30 l</td>
</tr>
<tr>
<td>Total size (LxWxH): 880 x 1000 x 1350 mm</td>
<td>Working level: 950 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heaters: 2 x 400 W</td>
<td>Bath movement: DC-gear motor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Special emphasis was put on a unique rinsing technique. A double cascade rinse and a spray rinse, the latter activated via foot switch and a magnetic valve, are integral parts of the COMPACTA 30.

We also offer the COMPACTA as a complete system including chemicals, anodes, anode holders and board holders.

COMPACTA 40 2CU

THROUGH-HOLE-PLATING LINE

Based on the same principle of construction as our Compacta 30 series, the Compacta 40 2CU is optimized for higher productivity. You can manufacture boards with a maximum size of 300 x 400 mm². This enlargement plus an integral, second plating bath leads to almost 4 times higher daily throughput with only little more space requirements.

Based on the COMPACTA-series we also produce machines for other chemical systems.

Alternatives for improved surface qualities:

Bungard is also experienced in galvanic nickel-gold-systems for long lasting, bondable surface quality. Moreover tin-, blackening- or sealbond-systems are available. Contact us for your individual, customized solution.

<table>
<thead>
<tr>
<th>COMPACTA 40 2Cu</th>
<th>Tank dimensions</th>
<th>treatment tanks</th>
<th>galvanic copper tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length: 500 mm</td>
<td>500 mm</td>
<td>Width: 100 mm</td>
<td>300 mm</td>
</tr>
<tr>
<td>Depth: 450 mm</td>
<td>450 mm</td>
<td>Capacity: 20 l</td>
<td>60 l</td>
</tr>
<tr>
<td>Total size (LxWxH): 1200 x 1180 x 1390 mm</td>
<td>Working level: 950 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight: approx. 130 kg</td>
<td>Heaters: 2 x 800 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectifier: 2 x 6 V, 80 A</td>
<td>Bath agitation: DC-gear motor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Power supply: 230 V, 50 Hz, 2,5 kW
**HITEC PLATE 2030 + 3040**

**UNIVERSALLY ELECTROPLATING MACHINE**

HitecPlate 2030 and HitecPlate 3040 are universally applicable electroplating machines for the deposition of metals and serve for the production of plated-through-hole printed circuit boards in vertical technology for prototype and small batch production.

The HitecPlate 2030 and HitecPlate 3040 are designed for direct metatllization and have baths for process steps cleaning, rinsing, pre-dipping, activating, rinsing, intensifying, rinsing, copper deposition.

**Features**
- Benefits of machine
- Modular construction
- Compact design
- Easy operation, easy handling
- Clean work flow

- Uniform deposition of copper on the surface and the drill hole
- Automatic rinse water exchange possible

**Construction of machine (basic module)**
- Machine frame completely made from PVC
- 5 treatment basin
- Electroplating tanks
- Separate rinsing section for every process step
- Automatic rinse water exchange possible
- Anode frame
- Drain valve and cover for each basin
- Air injection for copper bath
- Agitation on all tanks, infinitely adjustable
- 2 Titanium heater
- Main switch
- Electronic rectifier, current or voltage constant mode

**PROTEC 2030 + 3040**

**IMMERSION TIN FOR PERFECT LEAD-FREE SOLDERING**

The PROTEC SN is a professional equipment for the production of final surfaces of printed circuit boards. The machine includes all necessary tanks and electrical equipment in a very compact design.

**Features**
- Modular structure
- Compact design
- Easy operation, easy handling
- Clean work flow

- Because of the modular structure the following additional processes can be integrated into the equipment:
- Tinning (subtractive technology)
- Desmear, Blackening, tin stripping
- Immersion Tin
- Organic protective layer (OSP)
- Electroless nickel / gold or Immersion Silver
- Galvanic nickel / gold
- Stripper negative resist

**RLM 419 P**

**DRY FILM LAMINATOR**

The RLM is a dry film laminator especially made for small companies, schools, research and development departments. All commercial laminates for PCB manufacture and mould-etching technique can be processed. Due to adjustable pressure control and adjustable laminating speed, solder mask application is also possible without problems.

**Features**
- Easy and fast mounting of resist rollers of all common coil diameters
- Detachable inlet table for easy access to lower resist roll
- Infinitely adjustable laminating speed
- Electrically heated laminator rollers with uniform temperature distribution
- Separate transport rollers for non-creasing laminate transport
- Digital setting and read out of laminating temperature
- Manually adjustable laminating pressure
- For all common dry film resists with 3 and 5 inch core diameter
- Suitable for solder mask application

**Specifications**

- **HITECPLATE 2030**
  - Function: Plating-through-hole, copper galvanic
  - Max. Board size: 200 x 300 mm (250 x 350 mm)
  - Power supply: 230 V AC, 50 Hz - 60 Hz
  - Power consumption: 1500 W
  - Volumen Treatment tanks: 10 l
  - Volumen Galvanitic tank: 30 l
  - Weight: 130 kg
  - Dimensions (LxWxH): 1350 x 1250 x 760 mm
  - Working Height: 900 mm

- **HITECPLATE 3040**
  - Function: Plating-through-hole, copper galvanic
  - Max. Board size: 200 x 300 mm (250 x 350 mm)
  - Power supply: 230 V AC, 50 Hz - 60 Hz
  - Power consumption: 2000 W
  - Volumen Treatment tanks: 20 l
  - Volumen Galvanitic tank: 60 l
  - Weight: 200 kg
  - Dimensions (LxWxH): 1520 x 1250 x 867 mm
  - Working Height: 900 mm

- **PROTEC 2030**
  - Working area: 200 x 300 mm
  - Teflon heating elements: 2 pieces per 400 W
  - Dimensions: (LxWxH): approx. 790 x 710 x 1160 mm
  - Power supply: 230 V, AC

- **PROTEC 3040**
  - Working area: 300 x 400 mm
  - Teflon heating elements: 2 pieces per 800 W
  - Dimensions: (LxWxH): approx. 790 x 710 x 1160 mm
  - Power supply: 230 V, AC

- **RLM 419 P**
  - Lamination width max.: 400 mm
  - Transport width max.: 440 mm
  - Lamination speed: 0.2 - 1.0 m/min
  - Resist tension: adjustable
  - Lamination pressure: adjustable
  - Temperature range: 80 - 120° C
  - Power supply: 230 V 50 Hz / 2 kW
  - Weight: 38 kg
  - Dimensions (LxWxH): 690 x 630 x 570 mm

Latest and updated product specification is published under www.bungard.com © 07/2019 Bungard Elektronik
RBM 300
BRUSHING MACHINE
A professional brushing machine designed for use in small series production and laboratories. High quality wet-processing brushing machines for PCB production at low price are possible! The proof is the Bungard RBM 300. The smaller sister of our RBM 402 is reduced wherever possible but not at quality, endurance and high precision details.
Features:
- The RBM 300 has an oscillating brush with quick change device
- Oscillation frequency and transport speed are stepless variable
- Parallel height adjustment. In contrary to the single sided height adjustment, you will achieve a long term even brushing result only with double sided parallel height adjustment.
- Machine is equipped with a finishing brush used before laminating. Various brushes available.

RBM 300
Useable width: 300 mm
Board thickness: 0.3 - 3 mm
Conveyor speed: 0.2 - 2 m/min
Oscillation frequency: approx. 10 - 110 lifts/min
Oscillation stroke: 10 mm
Stroke speed: approx. 0.2 - 2 m/min
Rinsing system water consumption: 6.8 l/min.
Power supply: 230 V, 50 Hz
Dimensions (LxWxH): 760 x 590 x 415 mm
Weight: 80 kg

RBM 402 KF
BRUSHING MACHINES
The RBM 402 KF series is the highest developed brushing machine in our range and can be used for practically all cleaning operation during PCB manufacturing. It is ideally suited for professional prototyping or smallbatch production in modern PCB laboratories. The RBM 402 consists of a double sided wet processing brush compartment, a rinsing and a following squeeze-off zone and hot air drying compartment. The solid construction guarantees proper function and a long life time with a minimum of maintenance.
Features:
- Simple brush exchange via quick change device
- Precise parallel brush adjustment with hand wheel
- Oscillation and transport are stepless adjustable
- Digital read out for board thickness and power consumption of the brush motor
- Upper and lower brushing rollers are adjustable in pressure and have a digital read-out for the settings.
- The wet-processing system comes together with a powerful squeeze + hot-air dryer.
- The „KF“ is indicating an integral closed loop rinsing system. That is urgently recommended in order to comply with German and European waste water regulations.

RBM 402 KF
Working width: 400 mm
Conveyor speed: 0.2 - 2 m/min
Oscillation stroke: 10 mm
Oscillation frequency: 10 - 110 lifts/min
Brushing roller length: 410 mm
Brushing roller outside diameter: 89 - 91 mm
Brushing speed: 1360 rpm
Board thickness (rigid boards only): 0.3 - 5 mm
Board sizes: (min.) 80 x 175 mm
Rinsing system water inlet: 19 mm
Rinsing system water outlet: 40 mm
Rinsing system water consumption: 26 l/min.
Power supply: 230 V, 50 Hz, max. 16 A
Dimensions (LxWxH): 1110 x 750 x 1160 mm
Weight: 220 kg (RBM 402 KF)
170 kg (RBM 402 BLC)

Also available versions:
RBM 402 BLC: bench-top low cost version
RBM 402 KF: closed-loop version with tank and candle filters

RBM 402 BLC

Picture of RBM 300 KF
Picture of RBM 300 KF

Picture of RBM 402 KF
Picture of RBM 402 KF
RDC 15
DIP COATER
The RDC 15 is a machine designed for laboratory dip coating of modern liquid photoresist. Today a more and more popular application is the so called: "sol-gel-application". This machine was developed to meet the demand of a greater variety of speeds, iterations, dipping and drip off times and heavier workpieces.

Features:
- Lift bar for several workpiece fittings. The dipping height and the sizes of the aluminum profiles can be easily adapted to even dip-coat bulky items.
- The insertion and the drawing or coating speed is separately adjustable from 30-7200 mm/min.
- The dipping time as well as the drip-off-time (pause time up and down) is separately adjustable from 1 s up to 99 h : 59 min : 59 s. This enables the machine not only to coat but to precisely develop. This is of great importance with certain photo coatings of the miniature etching technology.
- Up to 8 iterations are possible.
- The working range of the lift bar can be adjusted via the control panel. The maximum size of the workpiece is therefore only limited by the maximum lift range of the machine and the size of your cuvette.
- Air vent with damper.
- Multi-speed setting for dipping, coating and positioning drives possible.
- Magnetic stirrer with programmable function and speed (1 - 999 1/min).
- Virtual end switch avoids unnecessary drives.
- Parameters are stored for the next job after switching off machine.
- Controller is tiltable and removable.

ULX 110
DRYING AND CURING OVENS
The universal oven is our classic appliance for temperature control in science, research and material tests in industry.

This machine is a perfect masterpiece in terms of technology and is made of high-quality, hygienic, easy-to-clean stainless steel. In regard of ventilation and control technology, overtemperature protection and precisely tuned heating technology all possible aims are perfectly fulfilled.

Features:
- Forced air circulation by quiet air turbine, adjustable in 10 % steps.
- Adaptive multifunctional digital PID-microprocessor controller with high-definition TFT-colour display.
- Digital backwards counter with target time setting, adjustable from 1 minute to 99 days.

AIR 2000
CONVEYORIZED PCB DRYER
Air 2000 is a conveyored PCB Dryer. Adjustable transport speed ensures perfect drying of holes and surfaces after all wet process sequences.

Features:
- Continuous drying
- Variable transport speed
- Suitable for different board thicknesses
- Low surface temperature
- Short heating-up time
- High throughput
- Bench top machine
- High quality construction

ULX 110
Max. loading of chamber: 175 kg
Dimensions (LxWxH): 864 x 745 x 844 mm
Inner dimensions (LxWxH): 400 x 560 x 480 mm
Liters: 108 l
Net weight approx.: approx. 78 kg
Temperature Range: up to + 300°C
Power supply: 230 V – 50/60 Hz / approx. 2.800 W

ULX 110
RDC 15
DIP COATER
The RDC 15 is a machine designed for laboratory dip coating of modern liquid photoresist. Today a more and more popular application is the so called: "sol-gel-application". This machine was developed to meet the demand of a greater variety of speeds, iterations, dipping and drip off times and heavier workpieces.

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Liters: 108 l
Net weight approx.: approx. 78 kg
Temperature Range: up to + 300°C
Power supply: 230 V – 50/60 Hz / approx. 2.800 W
COMPONENT FEEDER
The system enables the feeding of components in tapes as well as loose components.

Vision system
By means of a camera attached directly to the assembly head, you can view the entire pick & place process – enlarged on a monitor.

X/Y-locking device
The X/Y locking device ensures precision mounting. Individual movement axes can be locked. An automatic function independently locks the X and Y axes when the components are lowered or when placing a dispenser dot. This makes it particularly easy to place Melfs.

Head lightening
The dual LED-light of the pick and place area can be integrated optional. The LEDs are placed on both sides of the nozzle and enable the constant and permanent lightening under the assembling head.

The integration into the control mode of the Manipulator allows the menu routed activating depending on application.

Features:
- Ergonomic
- Integrated dispenser unit
- Camera fixture
- X/Y-locking device
- Head lightening
- PCB holders
- Desktop workplace
- High end quality

PCB holders
All manipulators have a universal circuit board holder by standard for single- or double-sided PCBs. Elastic holding fingers are adjustable and hold the board in place. Large PCBs can be handled on demand. Customer-specific holders can be adapted or realised directly at our plant.

BUNGARD PICK&PLACE SMT3000
Manipulator for the production of prototypes and small series. The patent-registered Pick & Place head enables the comfortable handling of SMD-components. The modular-built system can be configured for every use. It realizes the complete process - starting by dispensing of solder paste or glue up to assembling different components.

Features:
- Ergonomic
- Integrated dispenser unit
- Camera fixture
- X/Y-locking device
- Head lightening
- PCB holders
- Desktop workplace
- High end quality

Some of the features include:
- Outstanding reflow soldering quality for SMD and hybrid
- at air quartz oven Curis SMD adhesive
- Two heating zones
- Microprocessor controlled
- Reflow process view

HOTAIR 06
REFLOW OVEN
The H06 is a solder oven for SMD component with the use of lead free paste.
The oven is work-ing with full convection forced air during the preheat stage. When the reflow stage is entered the heating will be done by hot air and quartz lamps.
The lamps are needed to get a short ramp speed. Once the reflow set point is reached the lamp power will be reduced to a minimum. At this point 85% of the heating is caused by forced hot air. This unique feature makes the oven suitable for solder big SMD components and/or components with pads under their casing while using lead free paste.
With good maintenance and proper use the oven will serve your solder needs for a long time with high quality solder results.

Some of the features include:
- Outstanding reflow soldering quality for SMD and hybrid
- at air quartz oven Curis SMD adhesive
- Two heating zones
- Microprocessor controlled
- Reflow process view

HOTAIR 06
Power req.: 208/240 V1 phase 50/60 Hz
Rated power: max. 3650 W
Dimensions (LxWxH): 550 x 490 x 335 mm
Max. Substrate surface: 300 mm x 370 mm
Number of heating zones: 2 zones microprocessor controlled
Preheat time: 0-999 sec.
Preheat temp: 60-260°C
Reflow Time: 0-999 sec.
Reflow temp: 90-300°C
Heat up time to thermal stabilization: approx. 8 Minutes
Net weight: 18 kg
Options: connection inert gas N2 with flow meter
RMP 210 / RMP 3545
MULTILAYER PRESS

This high performance multilayer press was designed for PCB labs to enable quick prototyping of multilayer PCBs according to industry standards. Number of layers is only limited by the maximum lift of the press plates (38 mm). Using separating metal sheets one can press a couple of boards over each other at the same time.

A compact and floor standing aluminium rack contains all parts of the unit including pressure supply, press plates and heaters. The large loading door allows quick and easy access to the press chamber and is of course security switch protected.

A compressor, which is integral part of RMP 210 / RMP 3545 is stored in the back of the machine. In the front, you will find additional storage room for tools or boards (lower door).

The unit is controlled by two digital and adjustable thermostates, one digital timer as well as a pressure valve with pressure meter. Four strong air ventilators are activated automatically during cooling cycle.

Steps of multilayer production with RMP 210 / RMP 3545:
- Boards are pinned and stack is inserted into press plates.
- Pressure is created.
- Heater is activated.
- Heating up procedure.
- Press procedure at preset temperature.
- Cooling down under pressure.
- PCB stack is taken out of the machine.

The entire sequence will take approx. 3 hours if you start at 20°C and take out the PCBs at a temperature of 30°C. If you take up protective measures, you can remove the boards at higher temperatures and insert a new stack. This way the press cycle reduces to approx. 45 min. Gross size of the PCBs is 250 x 350 mm (or 350 x 450 mm) which corresponds to a PCB net size of 210 x 300 mm (or 300 x 400 mm). To register the layers of your multilayer you can use the register hole function of our software IsoCam and the Bungard Favorit fixes the layers with rivets.

### RMP 210 / RMP 3545

<table>
<thead>
<tr>
<th>Board size: RMP 210</th>
<th>RMP 3545</th>
</tr>
</thead>
<tbody>
<tr>
<td>gross</td>
<td>250 x 350 mm</td>
</tr>
<tr>
<td>net</td>
<td>210 x 300 mm</td>
</tr>
<tr>
<td>Pressure</td>
<td>&gt; 12 t</td>
</tr>
</tbody>
</table>

- Pressure: > 12 t
- Temperature: 250 °C (adjustable)

- Heating up: approx. 30 mm.
- Cooling down: approx. 120 mm.
- Weight:
  - RMP 210: approx. 180 kg net, approx. 220 kg gross
  - RMP 3545: approx. 430 kg net, approx. 460 kg gross
- Dimensions (LxWxH):
  - RMP 210: 650 x 650 x 1390 mm
  - RMP 3545: 830 x 870 x 1600 mm
- Power supply:
  - RMP 210: 230 V, 50 Hz, 16 A
  - RMP 3545: 400 V, 50 Hz, 32 A
In 1961, Heinz Hans Bungard (Picture) founded Bungard Elektronik GmbH & Co KG, which is nowadays a global player with representatives in 62 countries of the world and 3 manufacturing plants in Germany.
5. Set-off, right to retention
Only unaccepted or legally binding counter-claims may be offset against our invoices. Any right to a retention is exercised by the purchaser in connection with our claims is explicitly excluded.

6. Delivery
Delivery of our goods is explicitly made on behalf of and at the risk of the purchaser. The risk shall pass on to the purchaser when the ordered goods leave our premises. The same applies if goods are collected in our premises after notification of their readiness. We decide at our discretion on the most economical delivery method without assuming any liability for the chosen means of delivery.

7. Reservation of proprietary rights
7.1 All goods supplied remain our property until all of our claims resulting from the contract have been paid in full. The purchaser is entitled to dispose of such goods in the normal course of business provided that he processes the goods only to the extent necessary for this purpose and that the processing shall not diminish or destroy the identity of the goods. The goods remain our property until the full amount invoiced for such processed goods. Such right to co-ownership shall be safeguarded by the purchaser.

7.2 The purchaser shall transfer to us, as a security, his claims against third parties resulting from the resale of our goods in full or in the proportion of our claim. The purchaser is not entitled to assign these claims to third parties.

7.3 The purchaser is not entitled to mortgage or transfer the goods which are subject to reservation by way of security. The exception of this prohibition applies to legal remedies and is conditional to the timely assertion of the legal remedies. Any time limited claims shall immediately become due. If the value of the securities exceeds our claims by more than 20%, securities to a corresponding amount will be released by us on request at our discretion.

8. Warranty and transport damages
We supply all our machines under a 12 month in-house warranty on parts and workmanship. This means that in this period of time, we repair or, at our choice, exchange, defective parts free of charge and at our facilities. This warranty does not cover transport fees.

Any user intervention to the machine / appliance will void the warranty, if not explicitly requested by us. Normal wear (i.e. on drive belts or spindle bearings) or damage from user intervention (i.e. pulling pc boards from units under tension) are not covered by this warranty.

Our local representative / dealer is in charge of technical assistance in any case of damage. Details of repair / exchange measures and coverage of transport fees are to be handled between our representative and us.

The purchaser shall check possible damages of our supplied goods on transit or transport immediately upon receipt and inform us in writing of visible defects at the latest 8 days after receipt. Complaints made at a later date will not be accepted by us. The purchaser shall give us the opportunity to convince ourselves of the rightfulness of the claim. If a claim is justified, we may repair the damage, supply replacements or refund the purchase price at our discretion. Further claims of the purchaser, especially claims for damages, are explicitly excluded, unless certain features of the goods had been assured by us. Claims for faulty delivery will in any event come under the statute of limitation six months after delivery.

9. Withdrawal
When delivery in accordance with the contract is not possible for reasons beyond our control, we are entitled to withdraw from the contract. Such withdrawal shall not entitle the purchaser to assert any right against us.

10. Place of performance and jurisdiction, applicable law
The exclusive place of performance and jurisdiction for both parties shall be 51570 Windeck Germany. Any contract shall be governed by the law of the Federal Republic of Germany.

11. Severability clause:
If any clause herein is or will become invalid, such clause shall not affect the validity of the remaining clauses. The invalid paragraph shall be replaced by a valid clause which shall meet as closely as possible the legal and commercial purpose of the original one.